Report for 2002CO5B: Determining the Fate of Non-source Pollution from Septic Tanks in Turkey Creek Basin, Colorado, and Delineating Improved Management Practices

- Other Publications:
  - VanderBeek, G., E. Poeter, G.D. Thyne, and J.E. McCray, 2003, Ground-water availability in Turkey Creek Basin, Colorado, Geol. Soc. Amer., Abstracts with Programs, 35(5).
- Articles in Refereed Scientific Journals:
  - Dano, K., E. Poeter, and G. Thyne, 2002, Geochemical and geophysical determination of the fate of septic tank effluent in a mountain watershed, Colorado, Geol. Soc. Am. Abstracts with Programs, 34(6).
  - Thyne, G.D., C. Guler, and E. Poeter, 2003, submitted to Ground Water, Use of multivariate statistical and spatial analysis combined with geochemical modeling for the characterization of watersheds: Example from a fractured rock aquifer, Turkey Creek Basin, Colorado.
- unclassified:
  - Poeter, Eileen, G.D. Thyne, G. VanderBeek,and C. Guler, 2003, Ground Water in Turkey Creek Basin of the Rocky Mountain Front Rnge in Colorado, in Engineering Geology in Colorado - Contributions, Trends, and Case Histories, Association of Engineering Geologists, Denver, Colorado.
  - VanderBeek, G., E. Poeter, G. Thyne, J.E. McCray, 2002, Ground-water Availability in Turkey Creek Basin, Colorado, Geol. Soc. Amer., Abstracts with Programs, 33(4).

Report Follows:

SYNOPSIS

Problem and research objectives

The rapid growth of population and development in mountain watersheds caused Jefferson County of Colorado to begin collecting data in a pilot study of ground-water resources in the Turkey Creek Watershed. Located approximately 20 miles west of Denver, the local communities are served by a fractured-crystalline rock aquifer, typical of those in the western US that provide water through individual domestic wells and treat wastewater with individual sewage disposal systems. Resource managers in the county commonly assume that 90% of water pumped by a residence is returned to the ground water system via individual septic treatment systems. This is inconsistent with the observation that the surface water quality has declined since 1975, while the ground-water quality has been relatively constant. This discrepancy suggests that high permeability regolith may support strong lateral flow in shallow zones between sewage disposal systems and streams. Such a short-circuiting of domestic sewage return flows is consistent with the fact that ground-water levels have been declining over the last few decades. Although long-term hydrographs from individual wells are not available, static water level data at the time of drilling was contoured for wells drilled in the 1970s and the 1990s. The wells were drilled in different seasons and different years. Thus, the contours provide only a general sense of water level conditions. The data were gridded at the same locations, using a variety of algorithms. The average difference of hydraulic head at grid locations between the 1970s and 1990s indicates an average water level decline on the order of 150 to 200 ft for all of the gridding approaches. Separating the data seasonally revealed an average decline of 140 ft in summer water levels and 190 feet in winter water levels. Precipitation at Stapleton Airport, in nearby Denver, CO was below average during the 1970s and above average during the 1990s, consequently the difference in precipitation over the periods is not responsible for the decline. This hypothesis is also consistent with the observation that the few available hydraulic tests (single well tests) suggest very high storage coefficients (not borehole storage) that are not consistent with the fractured rocks.

This project will evaluate the possibility that septic system return flows are short-circuiting the deep ground water system via lateral flow through regolith on the bedrock surface and rapidly reaching streams.

Methodology

An existing septic system is examined. An EM31 survey is used to evaluate depth to bedrock, slope of bedrock, locate the water table, and identify the septic wastewater plume. A doser was installed to monitor discharge to the drain field. Thirty piezometers are installed to monitor water levels and acquire water samples for quality analysis and comparisons with water quality from the drain field. An evapotranspiration dome has been readied for the 2003 field season. Time-varying water levels and water quality are mapped. Water budgeting and analytical modeling identify the fate of the plume.

Principal findings and significance

Work is in progress. The septic plume travels laterally in the regolith, but appears to dissipate into the fractured bedrock before reaching the stream.

Twenty-seven shallow (<10 feet deep) piezometers have been installed downstream of the septic leach field of a single home in the Turkey Creek Basin. Holes were augered in the overlying regolith layer down to the regolith-bedrock interface. The piezometers have been installed in a grid pattern and ranging over one hundred feet downstream from the leach field.

The large mid-March snow (>4 feet) melted over the period between late March and late April. This large volume of water saturated the regolith layer overlying the bedrock and produced a large volume of sheet flow over the piezometer grid. The measured depth-to-water in most of the piezometers was 0 feet.

Weekly sampling since early April has shown a gradual drop in the depth-to-water measurement in each piezometer as the snowmelt moves through the regolith. Specific conductivity (SC) and temperature have also been measured weekly. The variations in SC have revealed the flow path of the septic plume (high SC). Several sets of samples from the piezometers have been collected. The chemical changes of the septic effluent with respect to distance from the leach field are being determined.

A dose counter was professionally installed in the dosing chamber of the septic tank. It digitally registers every dose of septic tank effluent that is flushed out of the tank. This indicates the volume of effluent that enters the leach field. Once the snowmelt is gone from the regolith layer, the dimensions of the zone of effluent saturation will be determined. From these volumes, the rate of effluent infiltration into the bedrock can be determined.